Modeling Potential Sites to Support Nearshore Marine Aquaculture on Hawai'i Island

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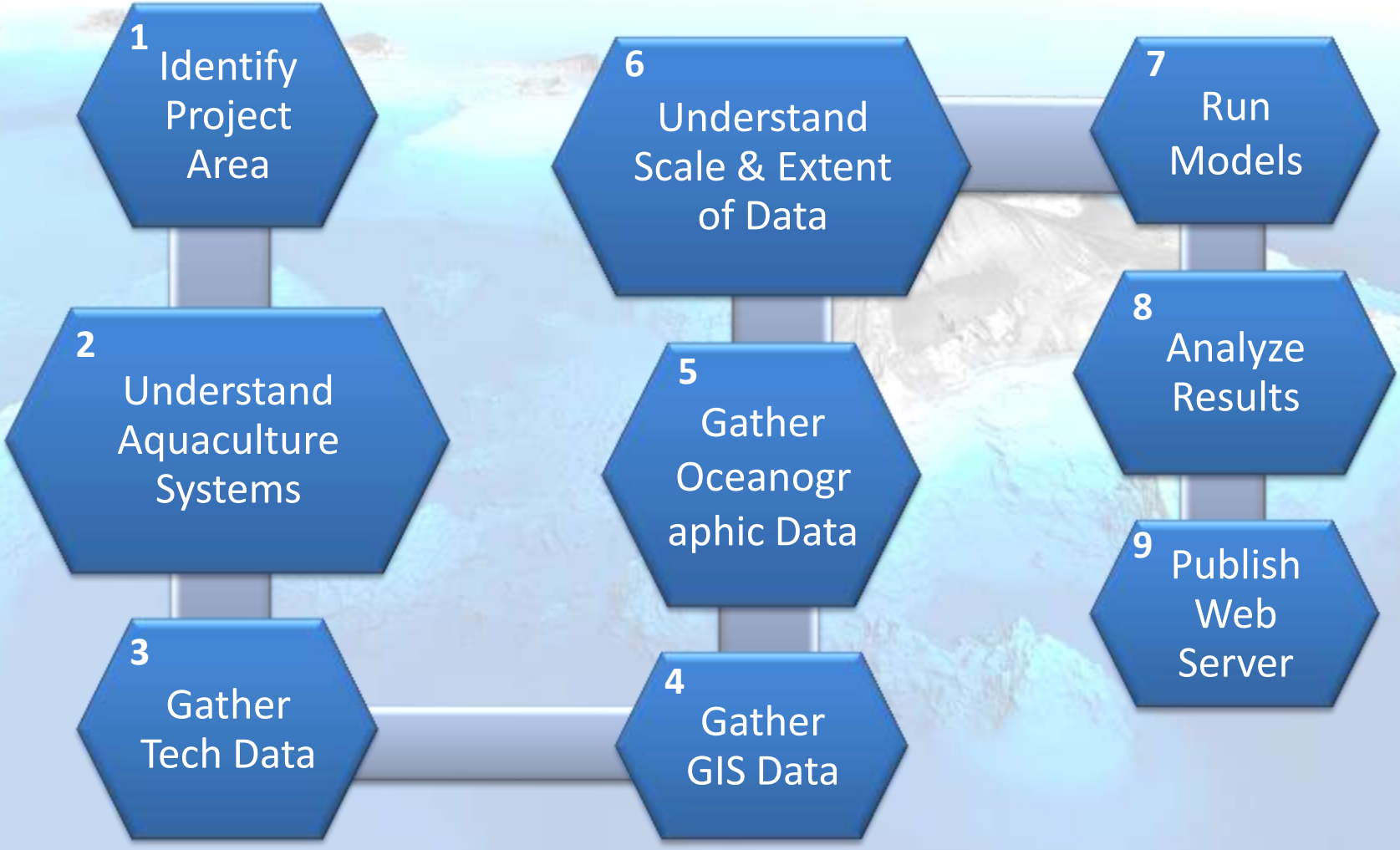
Goal

Understand the potential for marine aquaculture along the Big Island's coasts

Aquaculture systems and models

1. **Caged aquaculture**
   - brackish & oceanic finfish
2. **Line culture**
   - algae & bivalves
3. **Intertidal Bottom Culture**
   - bivalves
4. **Terrestrial Ponds**
   - freshwater fish, shrimp, limu
   - ornamentals, pharmaceuticals
5. **Hawaiian Fishponds, ponds**
   - range of fish species
   - limu, crustaceans
   - taro

Methods


1
Identify Project Area
2
Understand Aquaculture Systems
3
Gather Tech Data
4
Gather GIS Data
5
Gather Oceanographic Data
6
Understand Scale & Extent of Data
7
Run Models
8
Analyze Results
9
Publish Web Server

1. Project Design & Area

- **Focused on areas from shore to 3 Nautical Miles**
  (State Waters)
  - GIS parameters: NAD 83 UTM Zone 5N & State Plan
- **Sites identified by 100 hectare unique hexagons**
  - 5,997 hexagons total ((±1.5 nm of 3 nm)
  - 3,227 hexagons (0-3 nm)
  - 1,578 hexagons (0-200m); 390,000 acres

2. Aquaculture Requirements

Biophysical Constraints

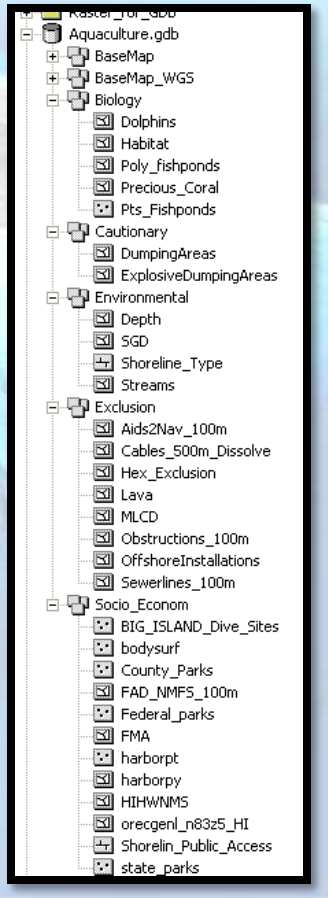
Water Conditions & Ocean Productivity	Ocean Conditions	Ocean Depth	Bottom Type
Salinity Turbidity Chlorophyll Temperature Chemical Factors (Oxygen & Pollution)	Tides Wave Height Flushing Roughness (Wind speed, Current Speed)	Depth Slope	Substrate Living Features

General Constraints

Current Zoning	Location & Economic Infrastructure	Physical Conflicts	Social Values
Marine Protected Areas Fishery Designated Areas Recreational Areas	Distance to Harbor Shoreline Access Shore-based Facility	Shipping lanes Buoys, Markers Military Dumping Area	Recreational Use Cultural Presence Viewshed

3-5. Data Gathering

- **Technical Data Requirements**
  - Based on aquaculture *Systems* needs from literature & expert sources
  - According to *Species* needs from literature & expert sources
- **GIS Data Compiled**
  - Over 75 different data layers compiled
  - Layers used in the model included in the Geodatabase
  - Metadata included with each layer
- **Oceanographic Data** (Satellite Imagery)
  - Ocean Currents, Wind Speed & Direction, Ocean color, Sea Surface Temperature, Ocean Tides, Ocean Waves

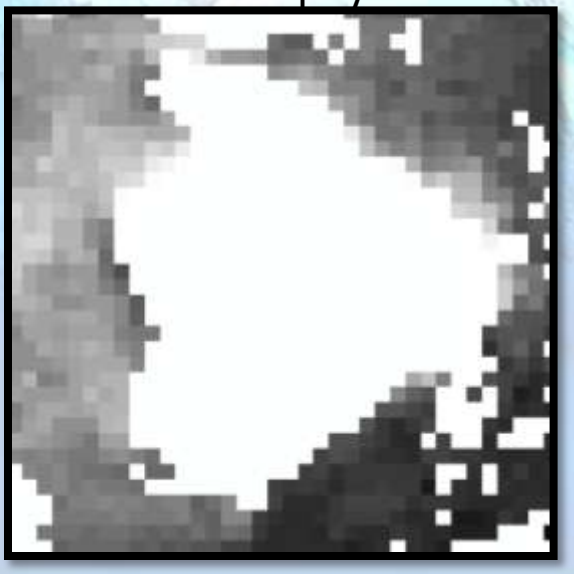


6. *Scale & Extent of Data*

- **All datasets used must be available Islandwide**
  - Site specific or incomplete coverage data not used
- **Scale of data compared to size of hexagons and systems requirements**
  - Important especially for satellite imagery

Wind Speed

October Chlorophyll minimum



7. Models

WHAT	WHY	HOW MUCH
Depth mbsynth50m	Water deep enough for water flow and little benthic impact.	> 4.5 m and < 30 m
Substrate Habitat	Can't deploy equipment on coral, or near cliff faces	No Coral Reef / Precious Coral
Distance from Shore Harbors/Ramps	About 30 min on a boat is the furthest you want to travel to access a site.	< 9 nm harbor or < 9 nm ramp
Salinity SGD & Streams	Known areas of freshwater streams and Submarine groundwater Discharge	50 m from streams and no SGD

8. Sample Model Results

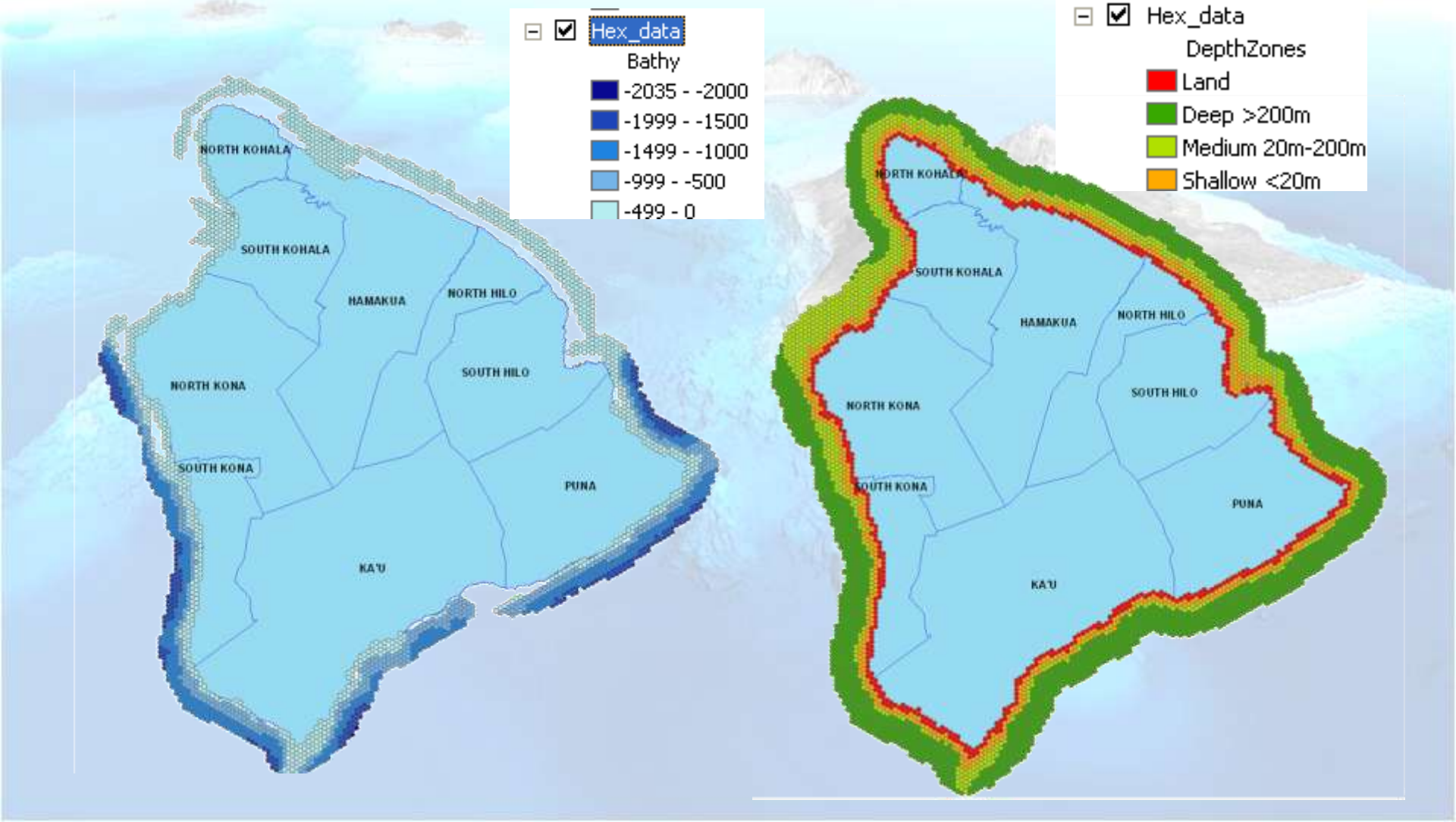
- Red = Not good
- Yellow = Obstructions
- Green = Good

Habitat

Habitat that has coral cover over 50% - 167 hex

Exposed Rocky Cliff shoreline

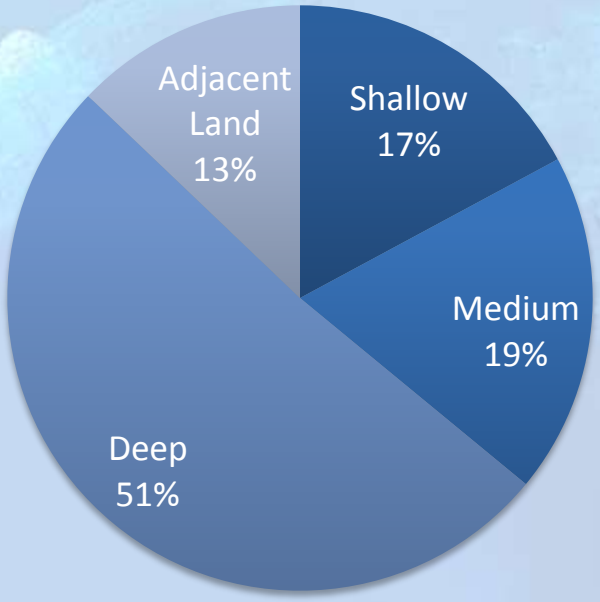
Depth using Multibeam and 20' and 200' contours



Depth to Seafloor

Depth Zones

- Shallow (<20m) – 772
- Medium (20-200m) – 848
- Deep (>200m) – 2304
- Adjacent to Land – 580



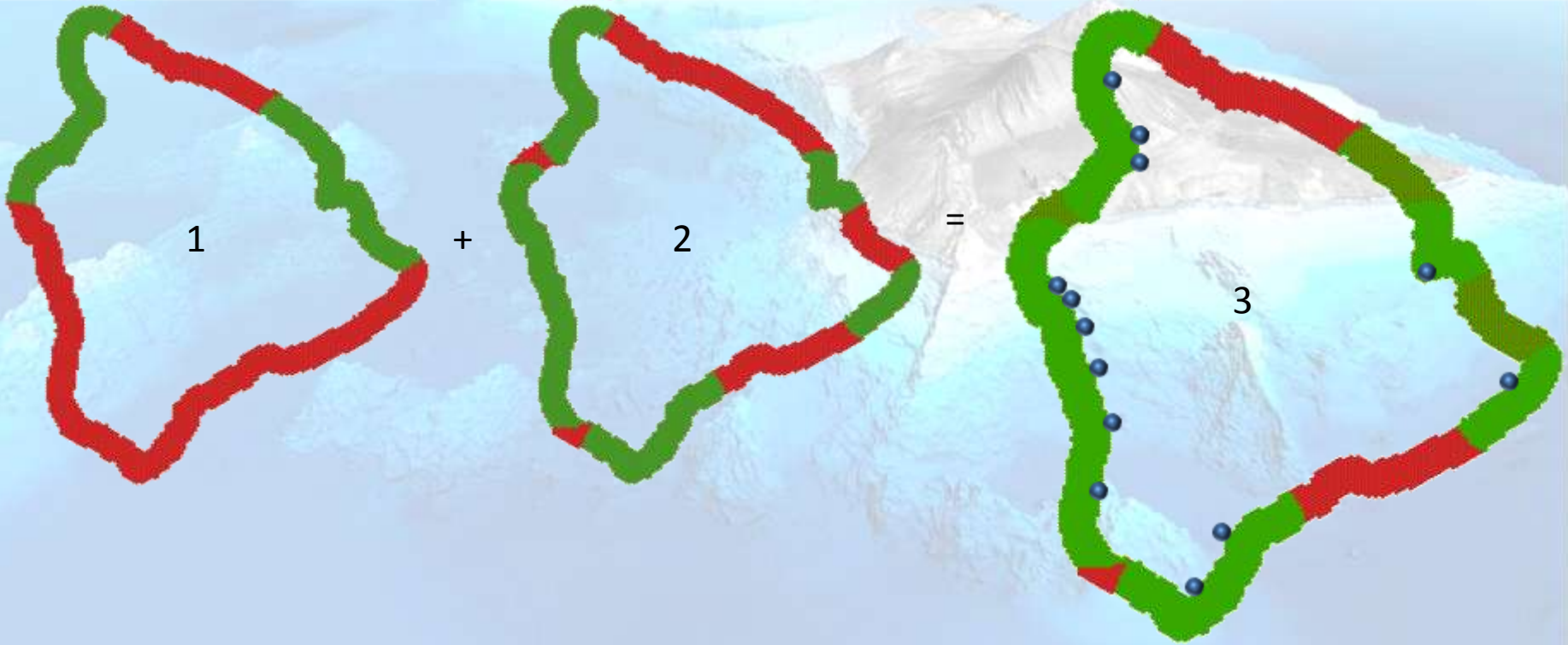
Bathy" < 0 AND "Bathy" > - 31

Distance from Boat Ramp or Harbor

25 nautical miles from small boat harbors (SBH)

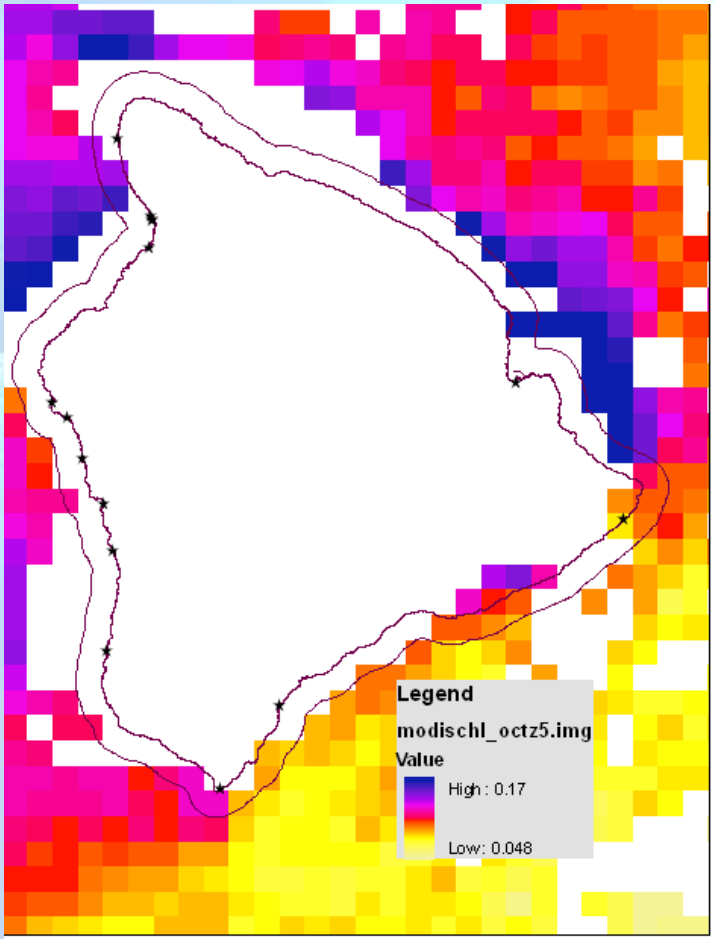
10 nautical miles from ramps, landings, SBH

Combined distances

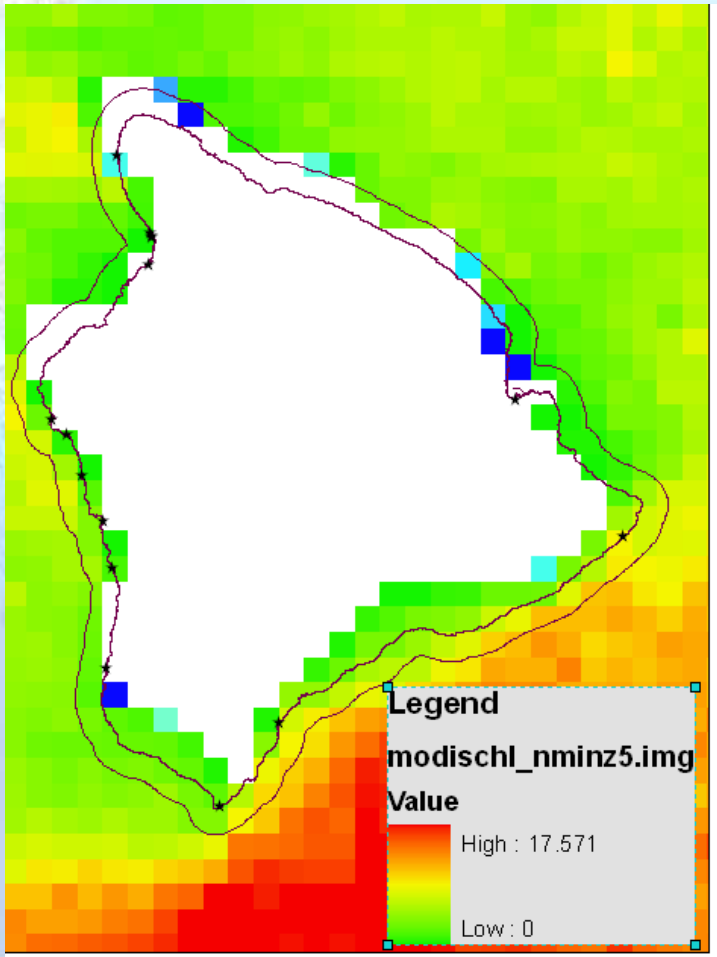


Plankton – Chl-A concentrations

Oct mean (month of lowest values)
2003-2009 monthly values



Number of weeks Chl-A less than 0.05 mg/m³



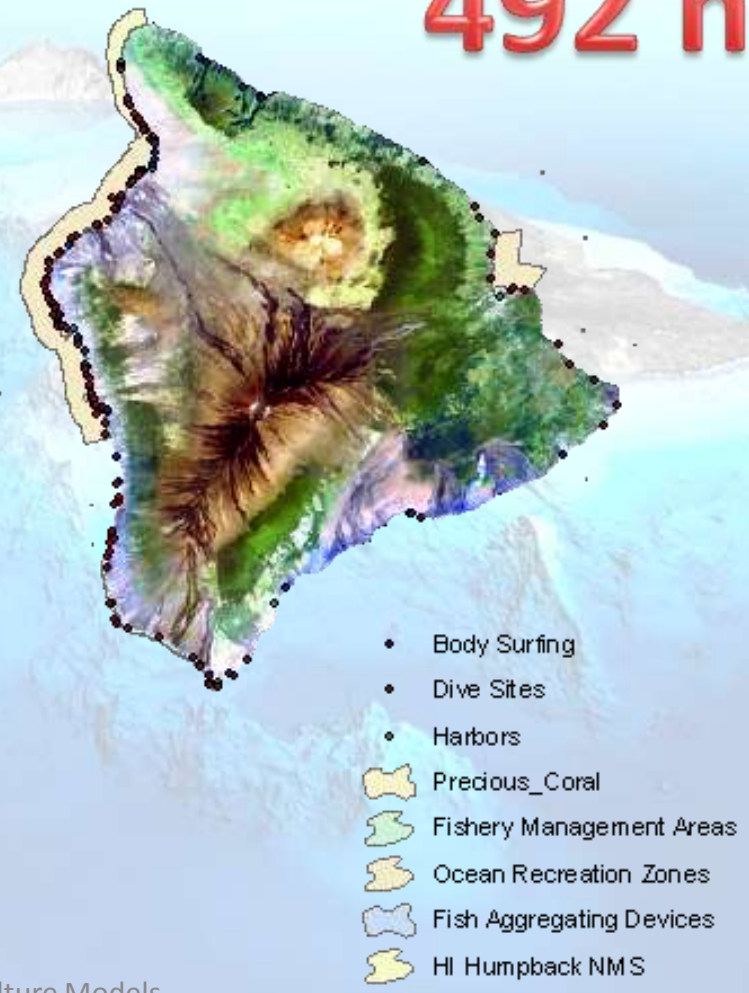
Obstruction Factors

- No Buoys (100 m); *14*
- No Cables (500 m); *26*
- No Sewer Lines (100 m); *2*
- No Lava Zone 1; *28*
- No Marine Life Conserv Districts; *20*
- No Offshore Installations; *10*
- No Obstructions (100m); *9*

Cautionary Factors (Socio-economic)

492 hex

- Fishery Managed Areas
- Hawaiian Islands
  Humpback Whale NMS
- Ocean Rec. Design. Areas
- Public Parks & Beaches
- SCUBA Dive Sites
- Fish Aggregation Devices
- Body Surfing Sites

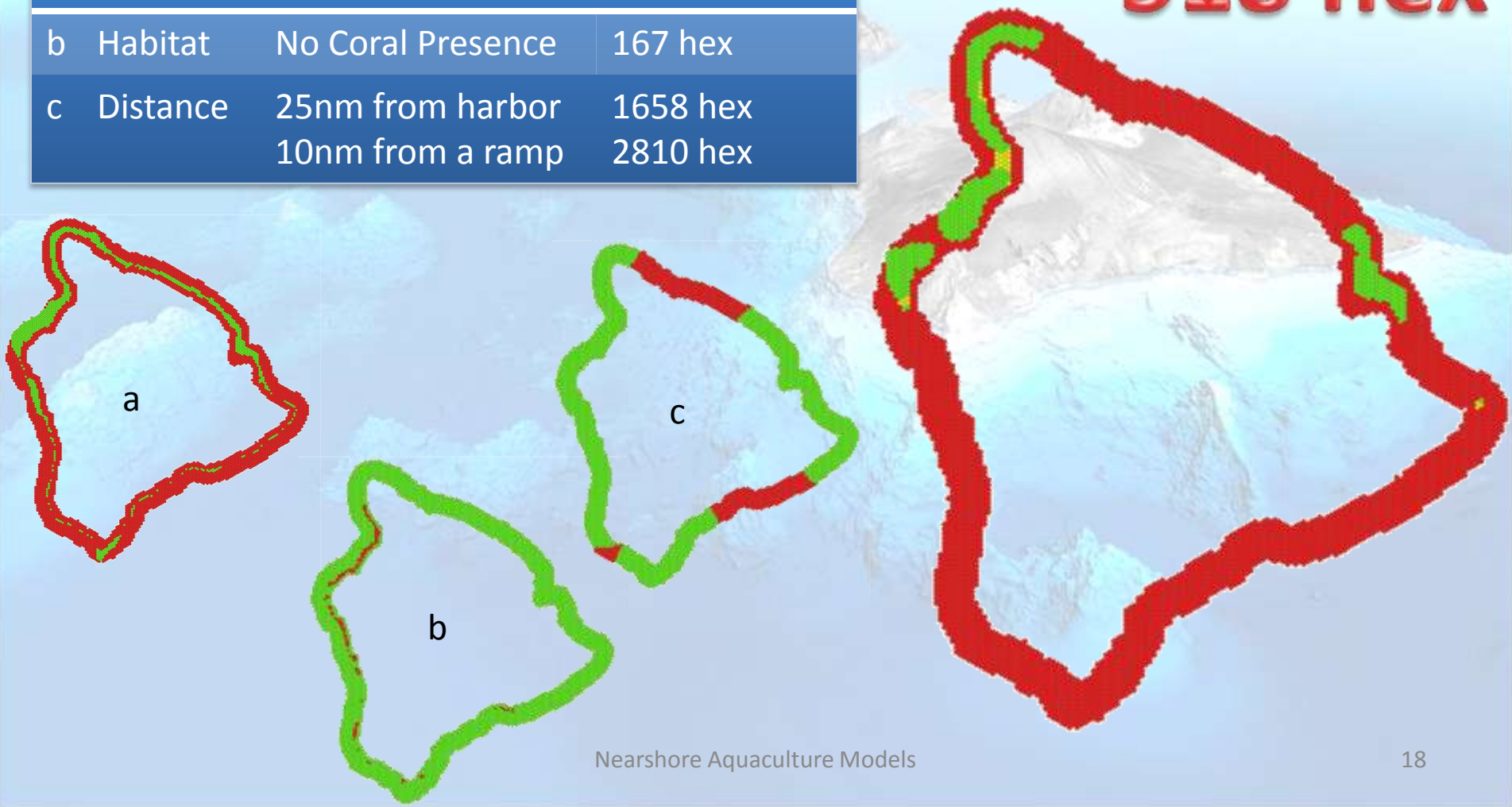


Caged Culture

128,000 acres

518 hex

a	Depth	20 - 200 m	777 hexagons
b	Habitat	No Coral Presence	167 hex
c	Distance	25nm from harbor 10nm from a ramp	1658 hex 2810 hex

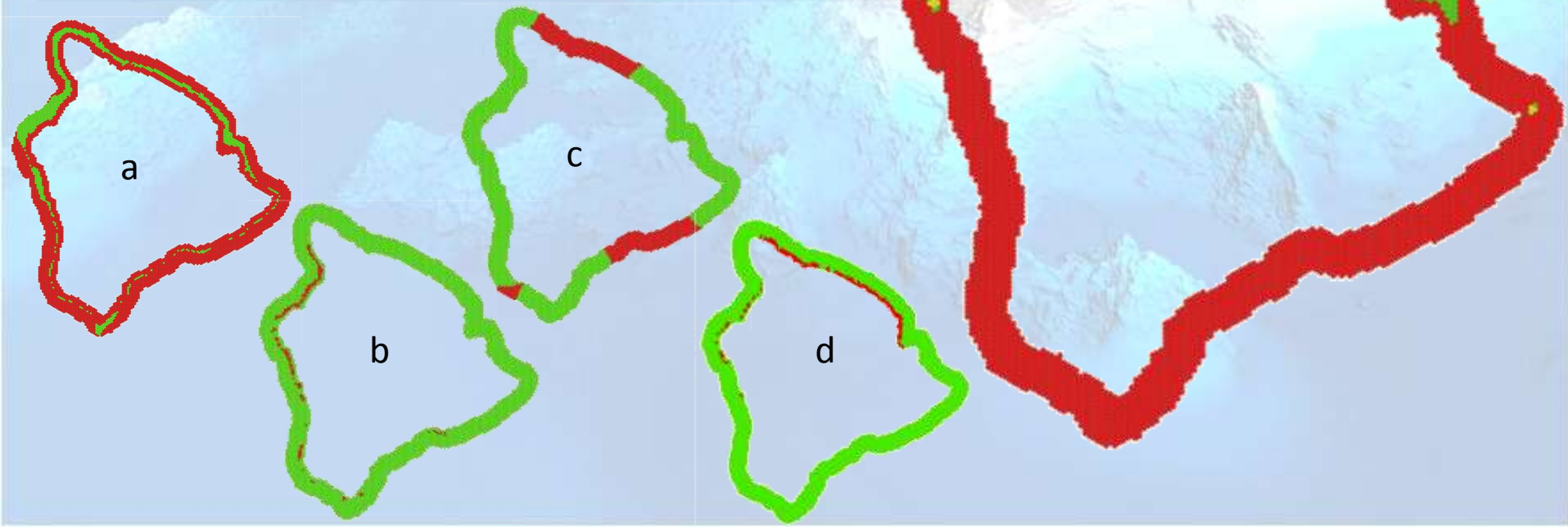


Line Culture

128,000 acres

518 hex

a	Depth	20 - 200 m	777 hexagons
b	Habitat	No Coral Presence	167 hex
c	Distance	25nm from harbor 10nm from a ramp	1658 hex 2810 hex
d	FreshH20	Perr Streams SGD	45 hex 226 hex

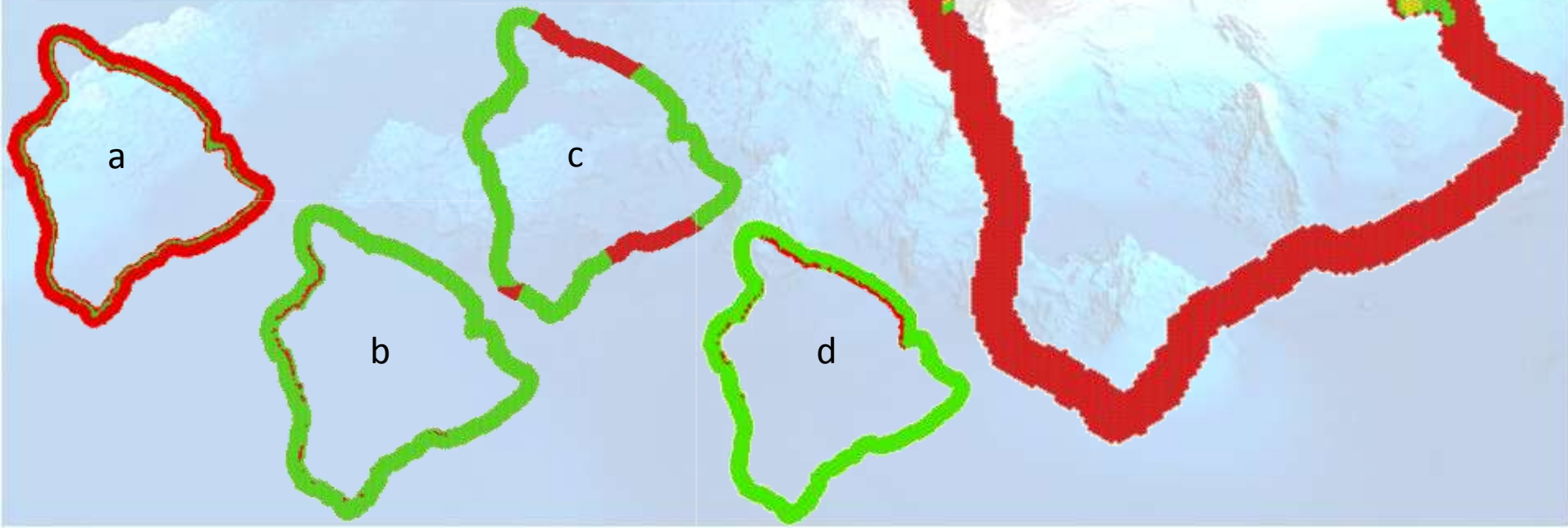


Intertidal Bottom Culture

4,243 acres

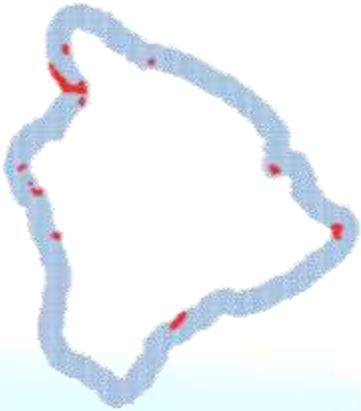
175 hex

a	Depth	4 - 30 m	772 hexagons
b	Habitat	No Coral Presence	167 hex
c	Distance	25nm from harbor 10nm from a ramp	1658 hex 2810 hex
d	FreshH20	Perr Streams SGD	45 hex 226 hex



http://vs1b.geodata.hawaii.edu/aquaculture/cropmodel/

Results & Progress



3 Systems Modeled

- Inter-tidal Bottom Culture
- Line Culture
- Cage Culture

3 Systems Mapped

- Traditional fishponds
- Sites for Raised or Earthen Tanks
- Sites for Seaweed Culture

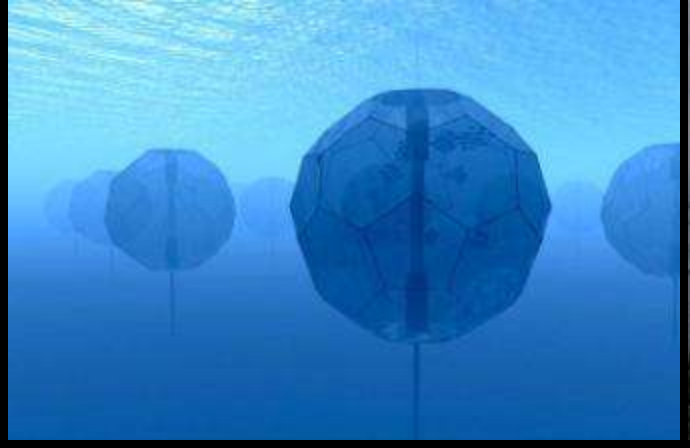
S. & N. Kohala

- Identified in all maps for potential
- Shallow Depth
- Close to Facilities

Depth

- Limited Shallow Areas
- MOORED SYSTEMS ONLY

Lack of Robust, Spatial Data

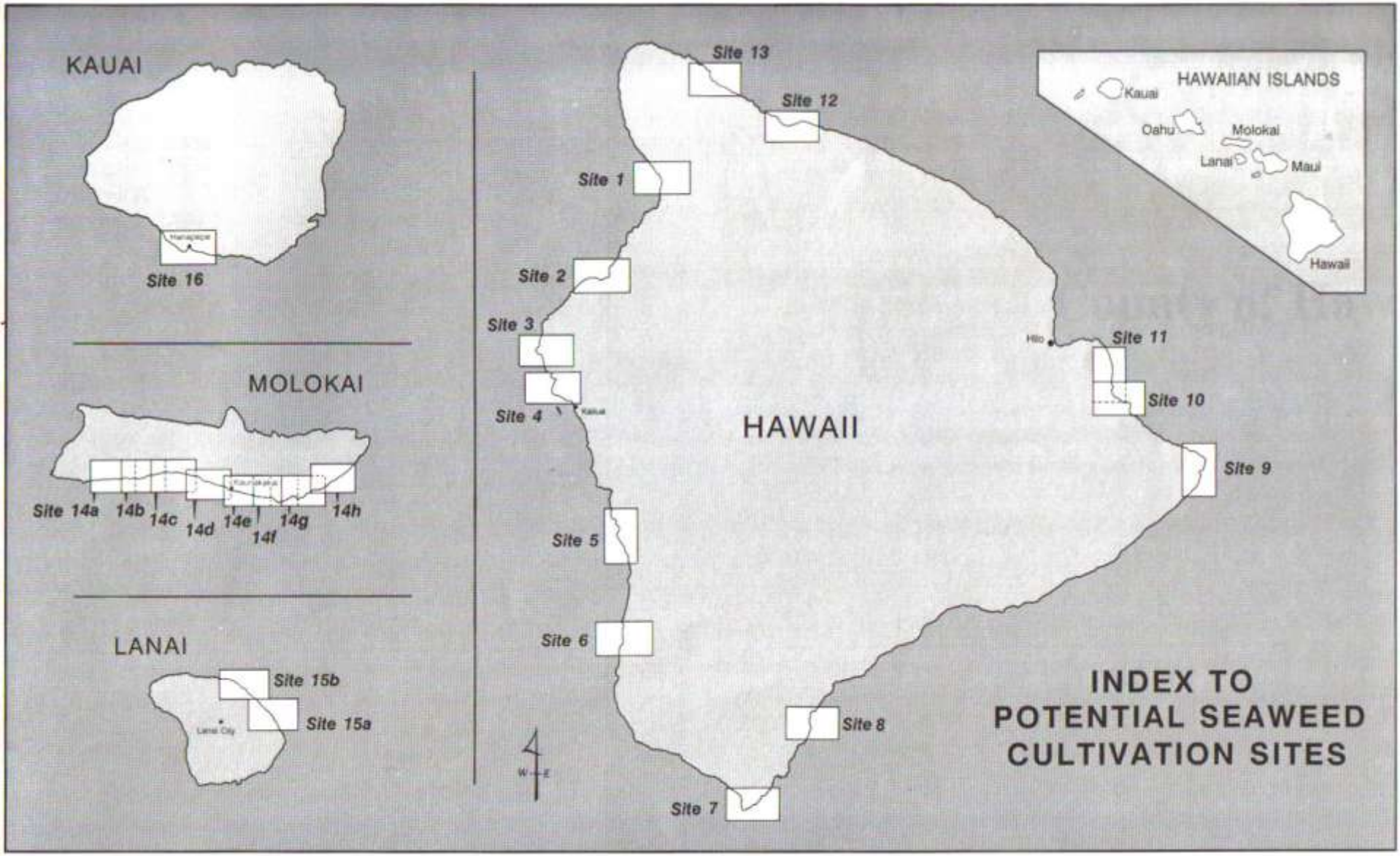





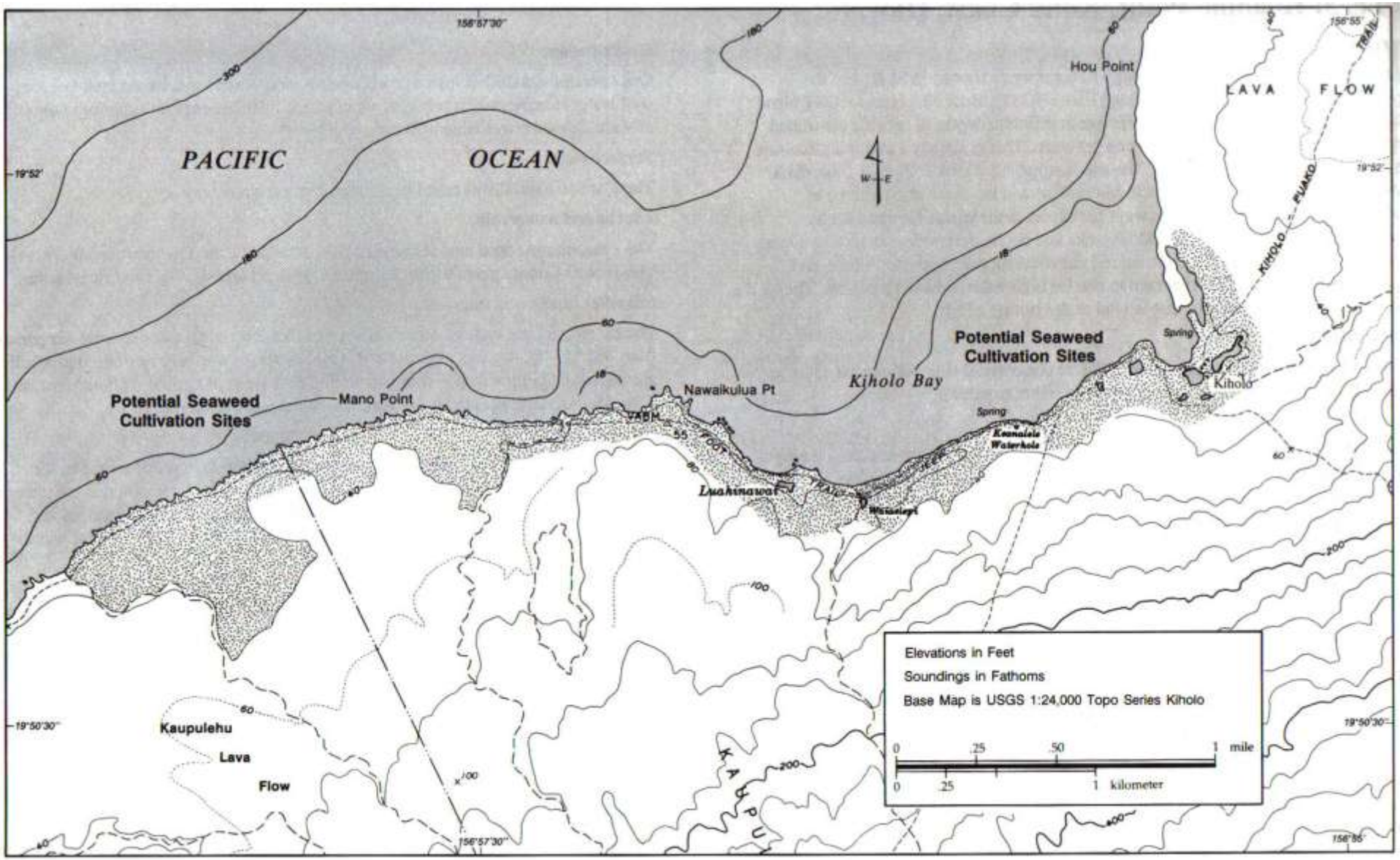


Questions to Think On…

How do you envision the future of Hawai'is Aquaculture….



Index to Site maps: for Hawaii, Kauai, Molokai, and Lanai



Site 2: Kiholo Bay, Kona Coast, Hawaii